

## CORRECTED VERSION

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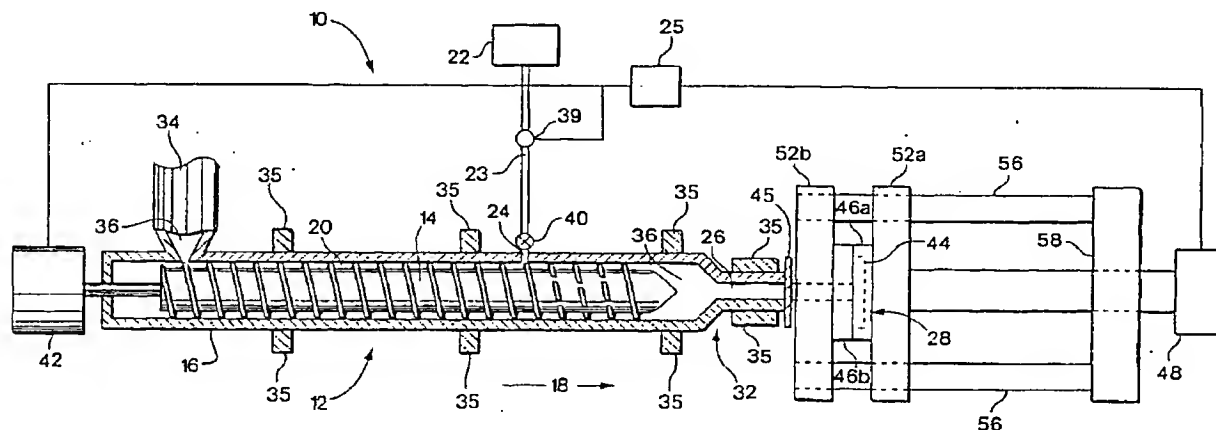
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12 December 2002

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(54) Title: INJECTION MOLDING SYSTEMS AND METHODS



**(57) Abstract:** Systems and methods for injection molding polymeric materials are provided. The systems and methods use a supercritical fluid additive. In some cases, the use of supercritical fluid additive enables formation of molded articles with low clamping forces and/or low injection pressures. Low clamping forces and/or low injection pressures may reduce the cost of a system designed to form a particular molded article. In some embodiments, the systems may include a control system that controls the operation of one or more components of the system (e.g., the extruder or the supercritical fluid additive introduction system). The systems and methods are suitable for forming polymeric foam articles including microcellular material articles.

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see PCT Gazette No. 50/2002 of 12 December 2002, Section II

*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

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GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC,  
LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW,  
MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SD, SE, SG,  
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GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent  
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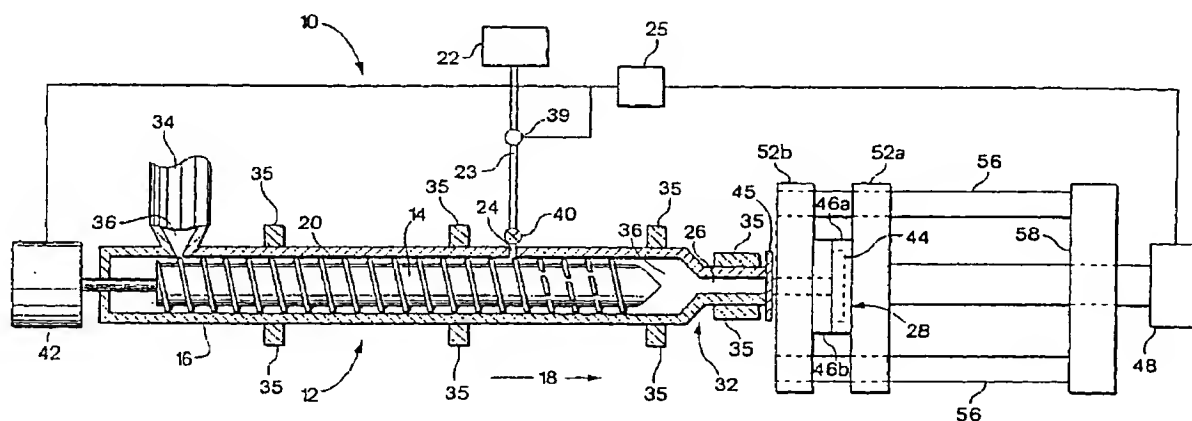
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tion II

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(54) Title: INJECTION MOLDING SYSTEMS AND METHODS



(57) Abstract: Systems and methods for injection molding polymeric materials are provided. The systems and methods use a supercritical fluid additive. In some cases, the use of supercritical fluid additive enables formation of molded articles with low clamping forces and/or low injection pressures. Low clamping forces and/or low injection pressures may reduce the cost of a system designed to form a particular molded article. In some embodiments, the systems may include a control system that controls the operation of one or more components of the system (e.g., the extruder or the supercritical fluid additive introduction system). The systems and methods are suitable for forming polymeric foam articles including microcellular material articles.



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# INTERNATIONAL SEARCH REPORT

International application No.

PCT/US02/14154

## A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) : B29C 45/50

US CL : 425/131.1

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 425/136, 140, 143, 145, 149, 169, 170, 462

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5,002,708 A (INABA et al) 26 March 1991 (26.03.1991), see entire document.	27, 34, 36-39, 41-46
Y	US 5,062,053 A (SHIRAI et al) 29 October 1991 (29.10.1991), see entire document.	4, 9-14, 18-22, 29-32, 36-41, 44-46, 104
Y	US 5,133,910 A (MANABE et al) 28 July 1992 (28.07.1992), see entire document.	4, 13, 14, 18-22, 26-29, 36-41, 44-46, 104
Y	US 5,256,345 A (YOKOTA) 26 October 1993 (26.10.1993), see entire document.	4-8, 13, 14, 18-32, 36-41, 104
Y	US 5,486,327 A (BEMIS et al) 23 January 1996 (23.01.1996), see entire document.	1-3, 15-17, 100-103
Y	US 5,641,523 A (SHIOIRI et al) 24 June 1997 (24.06.1997), see entire document.	4, 13, 14, 18-22, 104
Y	US 5,955,116 A (KEHOE et al) 21 September 1999 (21.09.1999), see entire document.	1-3, 15-17, 30-35, 100-103
Y	US 6,390,797 B1 (MYERS) 21 May 2002 (21.05.2002), see entire document.	1-3, 103



Further documents are listed in the continuation of Box C.



See patent family annex.

### \* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T"

later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X"

document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y"

document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&"

document member of the same patent family

Date of the actual completion of the international search

17 July 2002 (17.07.2002)

Date of mailing of the international search report

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Name and mailing address of the ISA/US

Commissioner of Patents and Trademarks

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# INTERNATIONAL SEARCH REPORT

International application No.

PCT/US02/14154

## Box I Observations where certain claims were found unsearchable (Continuation of Item 1 of first sheet)

This international report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claim Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claim Nos.:  
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☐ Claim Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

## Box II Observations where unity of invention is lacking (Continuation of Item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:  
Claims 1-46 and 100-104 relate to an injection molding apparatus with an extruder screw. Claims 47-99, 105 and 106 are injection molding with clamping means.

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.: 1-46 and 100-104

Remark on Protest

☐

The additional search fees were accompanied by the applicant's protest.

☐

No protest accompanied the payment of additional search fees.